RAPID UPDATE

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NSSL'S RAPID UPDATE SYSTEM

A Rapid Update version of the NSSL's SSAP code has been produced to satisfy the following goals:

Objective: Identify severe weather features prior to the end of a volume scan of radar data allowing users access to critical information in a timely fashion.

Primary Goal: Identify potential locations of severe weather features at the end of the first elevation scan of data and update icon locations.

Primary Goal: Update information on severe weather features once they are topped.

NSSL'S RAPID UPDATE SYSTEM

<u>Secondary-Goal</u>: Update information on intensifying severe weather feature attributes that are becoming more severe after each elevation scan.

For example:	maximum rotational velocity
maximum velocity difference

Four algorithms within SSAP were originally targeted for rapid update capability:

1) Mesocyclone Detection Algorithm (MDA)
2) Tornado Detection Algorithm (TDA)
3) Storm Cell Identification and Tracking (SCIT) algorithm
4) Hail Detection Algorithm (HDA)

RAPID UPDATE METHODOLOGY

• At the conclusion of the first elevation scan of a volume scan, new 2D features from SCIT, MDA, and TDA are identified.

• 2D features are time associated with 3D features from the previous volume scan.

• Forecasted tracks are applied to each 3D feature from the previous volume scan. The forecasted location at the next volume scan is compared with the actual locations of new 2D features. The closest 2D feature is time associated with the previous 3D feature.

RAPID UPDATE METHODOLOGY

• Associating features after the first elevation scan allows the range and azimuth of severe weather features to be updated immediately in the current volume scan. The position of the icon representing the severe weather feature on the display is changed accordingly.

• New 2D feature of the current volume scan inherits the attributes of the associated 3D feature from the previous volume scan.

• Low Level / Base attributes are updated.
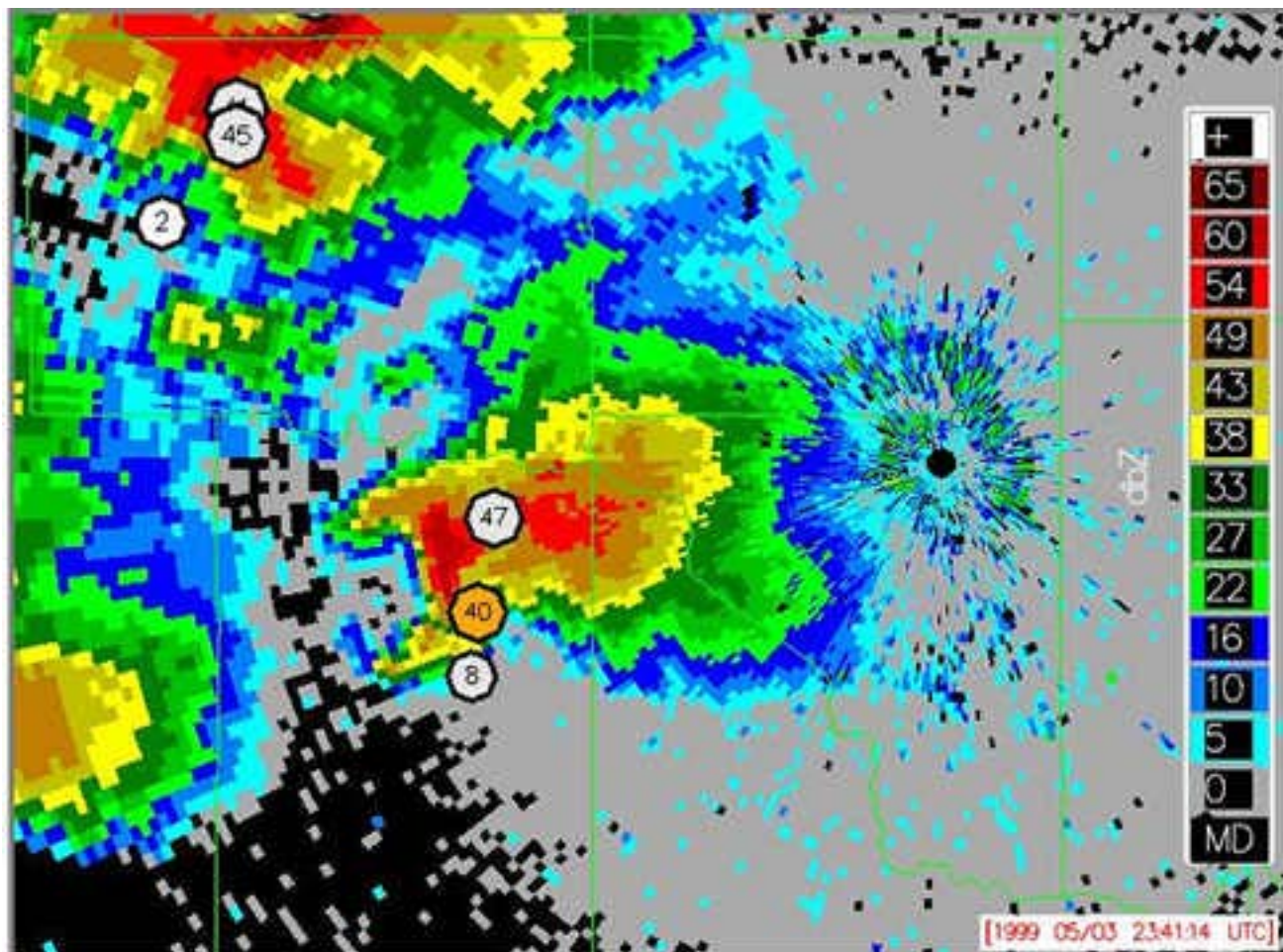
RowName	Azimuth	Range	CellId	Circ	MesoRank	MSI	Base	LLDiam	LLRotV	MXRotV	MXShear	MXgtg	Dir	Speed
40	252	49.7	6	CPLT	10	7816	0.5	3841.0	35	35	84	70	missing	missing
1	251	113.5	2	TVSMes	6	4769	1.7	4295.0	18	30	29	57	221	10
45	295	78.0	4	Circ	4	2759	3.6	2626.0	14	21	20	26	missing	missing
8	246	52.5	6	Circ	3	2237	1.5	2714.0	12	15	8	18	311	15
2	287	83.1	11	LowTop	3	2165	1.1	1393.0	7	18	13	28	173	11
6	307	78.5	4	Circ	2	1676	3.7	2792.0	10	15	7	17	274	31
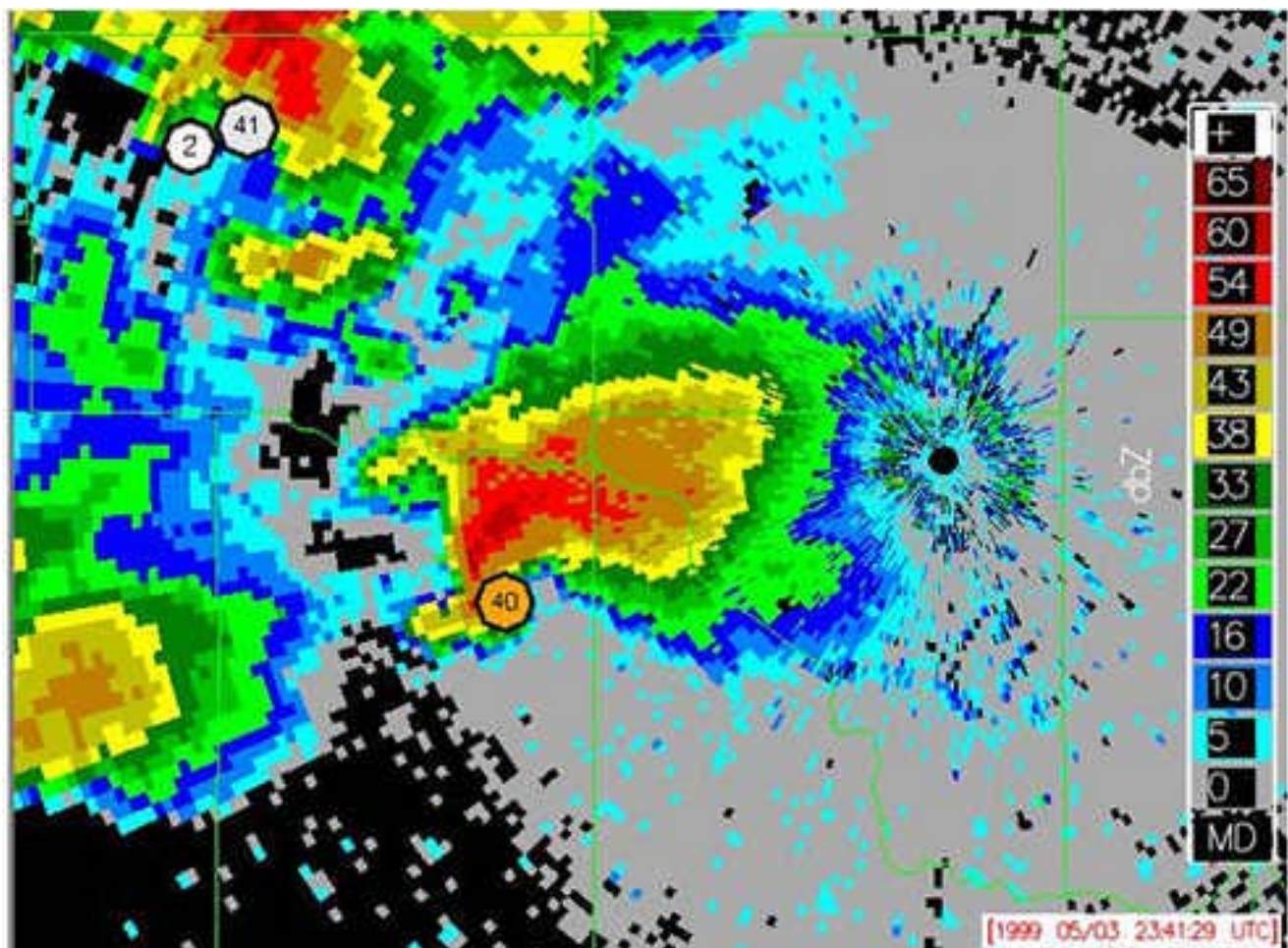
[1999 05/03 23:41:29 UTC]

RowName	Azimuth	Range	CellId	Circ	MesoRank	MSI	Base	LLDiam	LLRotV	MXRotV	MXShear	MXgtg	Dir	Speed
40	252	47.0	6	CPLT	10	7816	0.5	1643.0	35	35	84	70	253	9
1	252	111.1	2	Meso	6	4769	1.7	2406.0	18	30	29	57	218	10
2	293	83.0	17	LowTop	3	2165	1.1	2965.0	7	18	13	28	193	19
41	296	78.5	6	Circ	1	1843	1.0	8134.0	7	19	9	24	336	8
39	307	85.5	72	Circ	2	1349	2.8	7365.0	6	15	4	18	15	26

RAPID UPDATE METHODOLOGY

ALGORITHMIC ATTRIBUTES CALCULATED
AFTER FIRST ELEVATION SCAN

|	
MDA	Base Height Low-Level Diameter Low-Level Rotational Velocity Low-Level Shear Maximum Shear Low-Level Gate-to-Gate Velocity Difference
TDA	Base Height Low-Level Velocity Difference Low-Level Shear
SCIT	Base Height

RAPID UPDATE METHODOLOGY

• As each additional elevation scan of data is made available within the current volume scan, vertically adjacent 2D features are associated to produce a 3D feature.

> • TDA allows a vertical gap of one elevation angle between 2D components. SCIT allows for vertical merging of storm cells separated vertically by less than 4 km or 3 degrees in elevation.

• After each elevation scan, severe weather feature attributes that intensify are updated immediately.

• Once the 3D feature is completely built (or topped), all attributes of the new 3D feature are computed with information from the current volume scan.

RAPID UPDATE METHODOLOGY

ALGORITHMIC ATTRIBUTES THAT CAN BE UPDATED AFTER EACH ELEVATION SCAN

SCIT	Top Height Maximum Reflectivity Height of Maximum Reflectivity VIL
HDA	Probability of Hail Probability of Severe Hail Hail Size

MDA	Circulation type Top Height Depth Maximum Diameter Maximum Rotational Velocity Maximum Shear Maximum Gate-to-Gate Velocity Difference Mesocyclone Strength Rank Mesoscyclone Strength Index Probability of Tornado Probability of Severe Weather
TDA	Circulation type Top Height Depth Maximum Velocity Difference Maximum shear
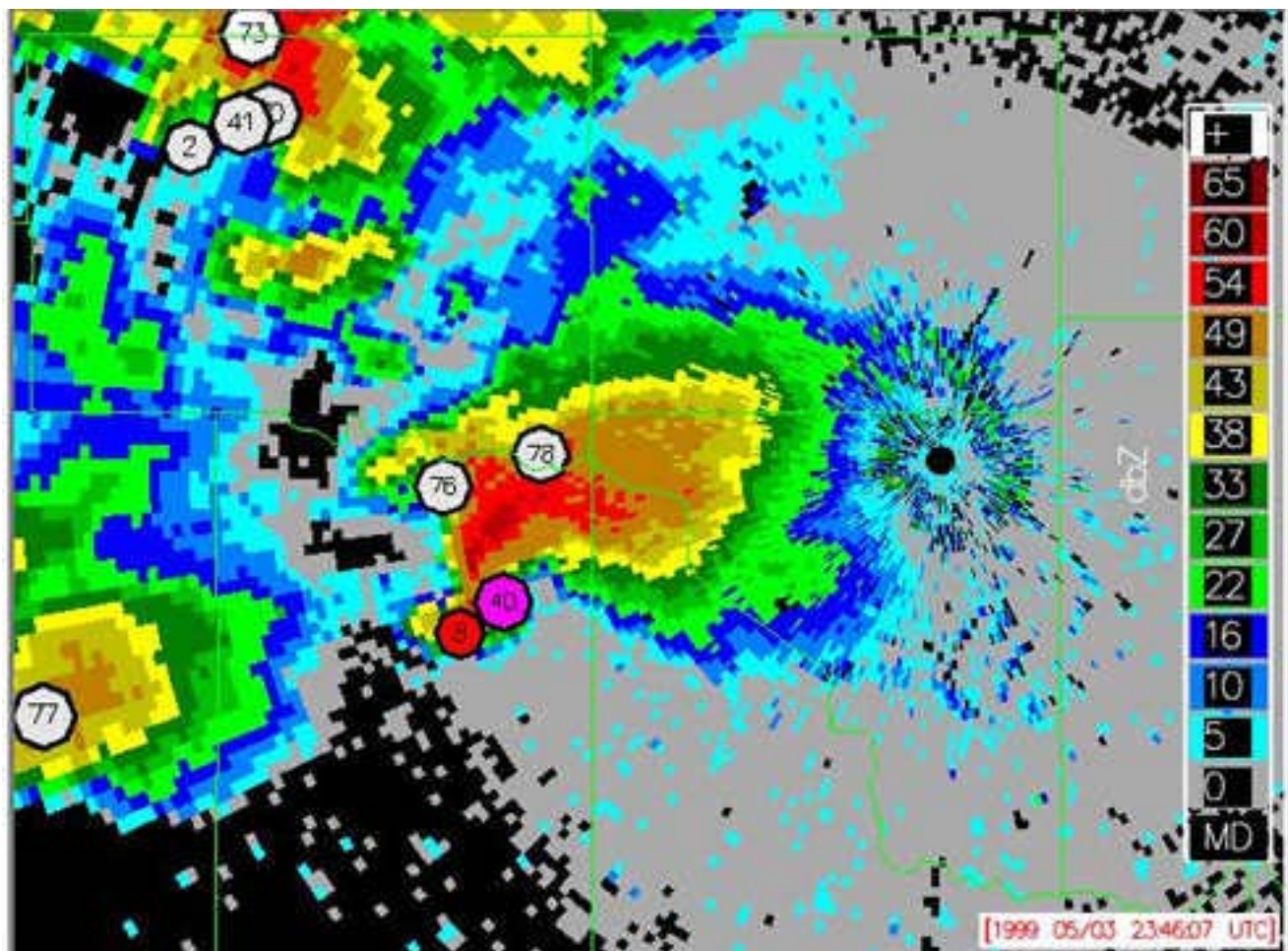
[1999 05/03 23:46:07 UTC]

RowName	Azimuth	Range	CellId	Circ	MesoRank	MSI	Base	LLDiam	LLRotV	MXRotV	MXShear	MXgtg	Dir	Speed
40	252	47.0	6	TVSMes	10	7633	0.5	1643.0	32	32	69	61	253	9
8	251	51.5	6	Meso	6	4028	4.0	1545.0	17	24	21	35	240	5
70	297	76.0	4	Circ	4	2815	3.3	3907.0	11	21	9	20	missing	missing
2	293	83.0	4	Circ	3	2676	1.1	2965.0	11	13	9	25	193	19
73	302	81.8	4	LowTop	3	2536	2.5	5619.0	16	16	10	22	missing	missing
41	296	78.5	4	Circ	3	2253	2.4	8134.0	13	18	6	15	336	8
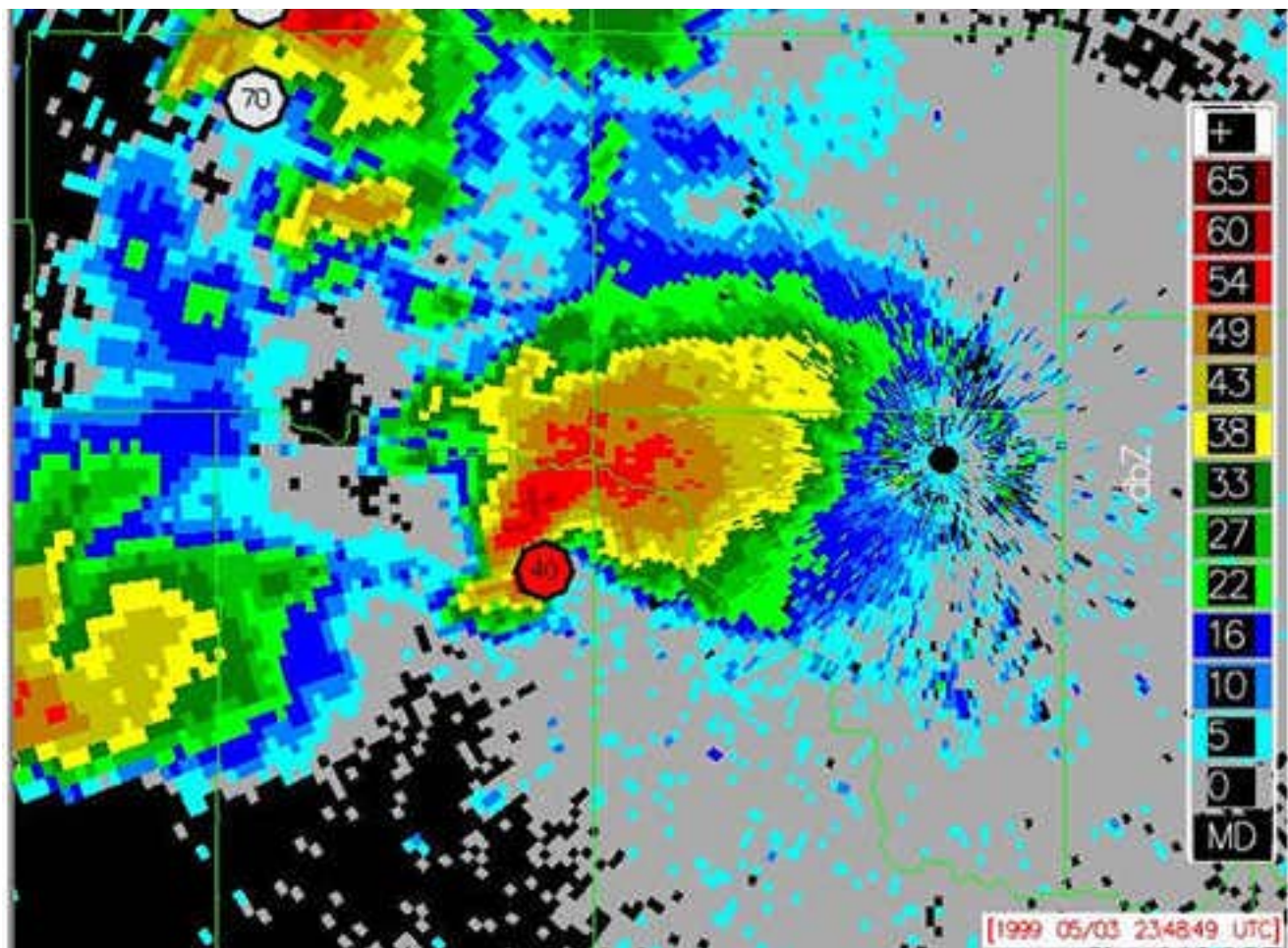
[1999 05/03 234849 UTC]

RowName	Azimuth	Range	CellId	Circ	MesoRank	MSI	Base	LLDiam	LLRotV	MXRotV	MXShear	MXgtg	Dir	Speed
40	255	42.2	6	Lowtop	5	7802	0.4	2372.0	30	33	85	66	240	13
104	253	101.8	0	Circ	3	5497	3.3	6951.0	15	39	14	55	missing	missing
101	252	107.1	7	CPLT	7	5193	1.6	3627.0	20	26	26	51	missing	missing
102	305	125.9	6	CPLT	6	3256	4.2	4580.0	12	22	14	38	missing	missing
103	320	92.6	4	Circ	2	2815	1.3	1630.0	9	21	11	20	missing	missing
70	298	78.3	4	Circ	4	2536	2.5	8055.0	18	18	16	24	131	8

RAPID UPDATE TIMELINE

A   B   C   D

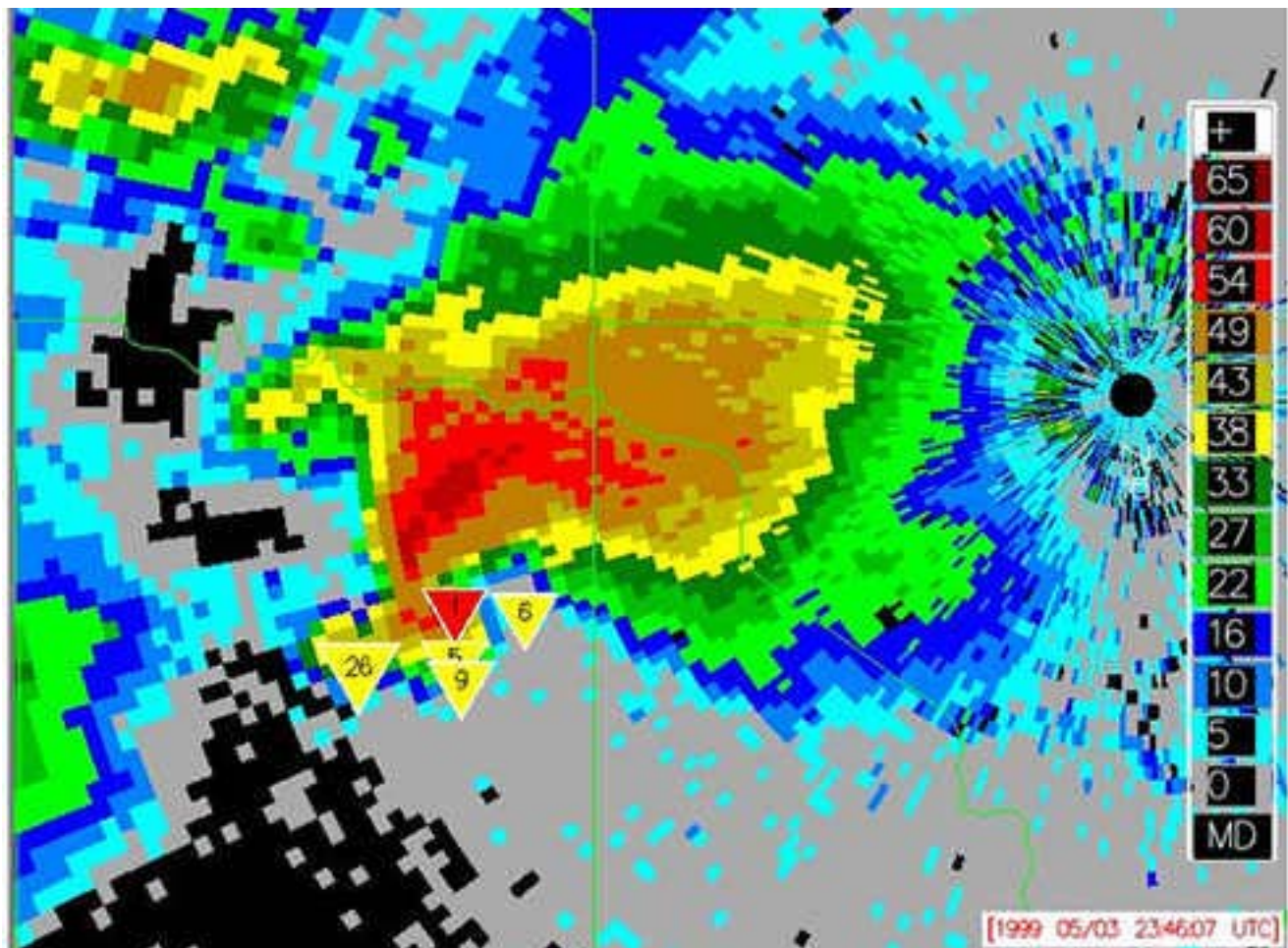End of VS_n Begin VS_{n+1} all intervening elevation scans for VS_{n+1} End of VS_{n+1}
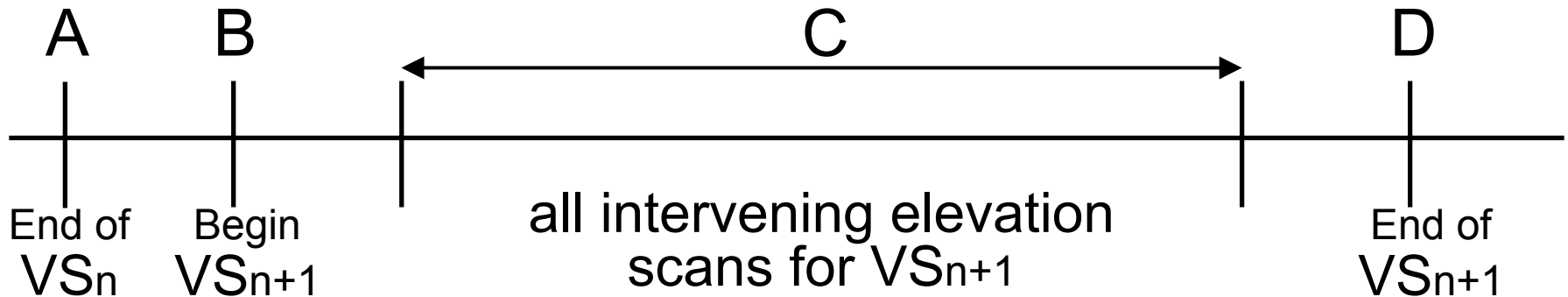
A – 3D features from previous volume scan are finalized

B – 2D features in current volume scan are time associated with 3D features from previous volume scan and feature attributes are 'coasted'

C – New 3D features are built. Feature attributes updated if:
    1) 3D feature is topped
    2) Feature attributes are intensifying

D – All 3D features are topped and attributes updated

RAPID UPDATE METHODOLOGY

Additional Considerations

• If a 2D component never becomes a 3D feature, then tracking information associated with the 2D component is removed from the 3D feature.

    • The 3D feature from the previous volume scan is free to be time associated with a new 2D (or 3D) feature from the current volume scan.

    • If a new time association occurs for the 3D feature, tracking information is recalculated.

• New detections not associated with previous 3D features are added as they are topped.

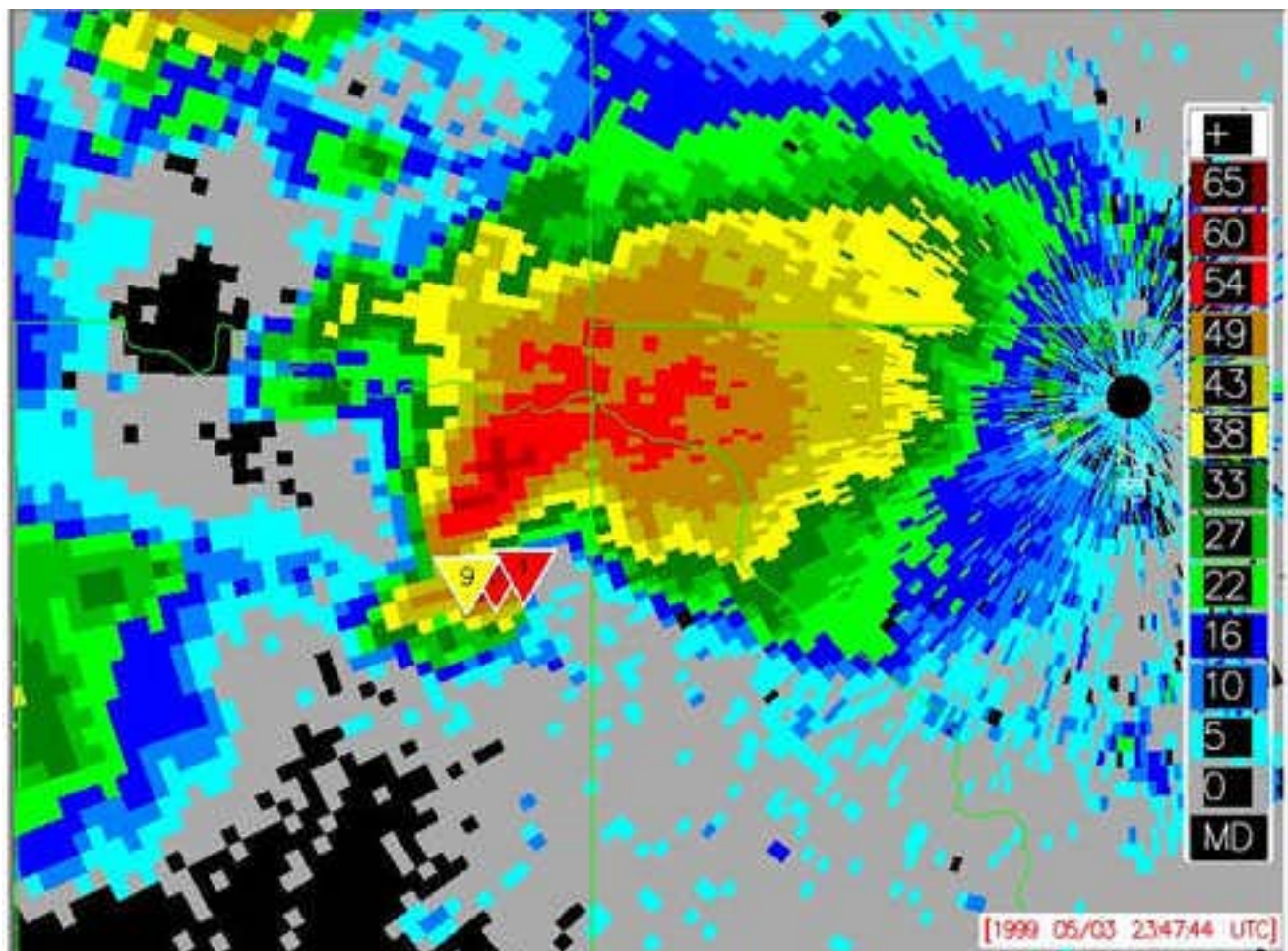• Should SCIT and HDA be included in rapid update?

[1999 05/03 23:46:07 UTC]

RowName	Type	Azimuth	Range	CellId	MesoId	Base	Top	Depth	LLgtg	MXgtg	LLShear	MXShear	Dir	Speed
1	TVS	253	47.0	6	40	0.5	9.1	8.6	52.0	86.0	64.0	93.0	231	18.0
2	TVS	252	110.5	2	0	1.6	10.0	9.1	42.0	51.0	22.0	27.0	211	13.0
4	TVS	302	124.0	1	0	2.0	10.0	8.3	18.0	52.0	8.0	24.0	211	26.0
23	TVS	293	83.0	4	0	1.1	9.5	8.4	17.0	18.0	12.0	12.0	225	15.0
24	ETVS	254	101.2	2	0	4.9	10.0	8.0	54.0	54.0	31.0	31.0	205	33.0
11	ETVS	252	111.5	2	0	3.7	9.5	7.0	34.0	59.0	17.0	31.0	201	48.0

[1999 05/03 23:46:26 UTC]
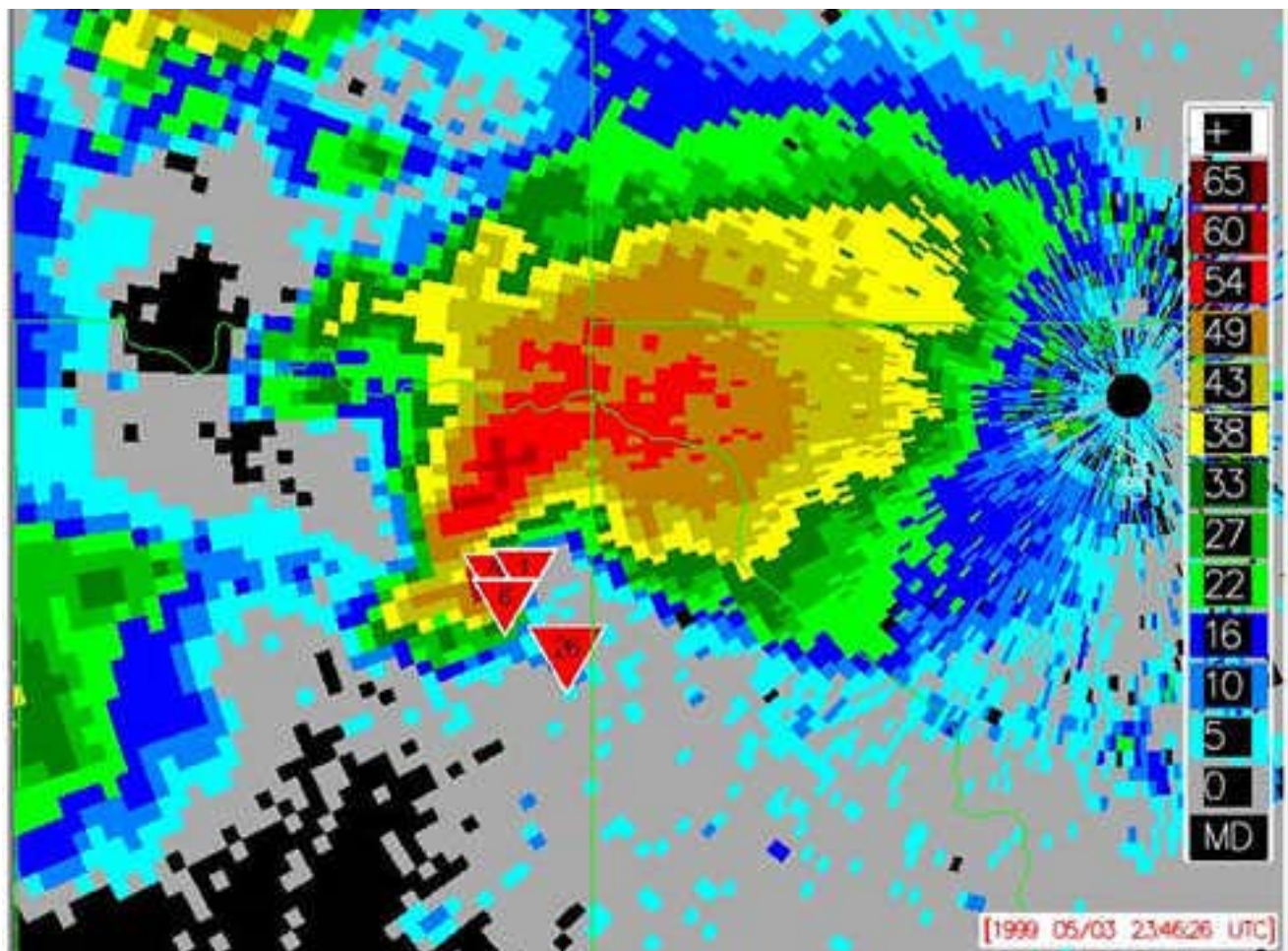
RowName	Type	Azimuth	Range	CellId	Mesold	Base	Top	Depth	LLgtg	MXgtg	LLShear	MXShear	Dir	Speed
5	TVS	255	43.6	6	0	0.5	0.5	missing	51.0	51.0	67.0	67.0	missing	missing
2	TVS	253	107.3	2	0	1.6	1.6	missing	41.0	51.0	22.0	27.0	211	13.0
11	TVS	253	104.9	2	0	1.5	1.5	missing	28.0	59.0	15.0	31.0	201	48.0
4	TVS	305	125.5	1	0	2.0	2.0	missing	24.0	52.0	11.0	24.0	211	26.0
1	TVS	254	41.7	6	40	0.4	0.4	missing	23.0	86.0	32.0	93.0	231	18.0
23	TVS	295	78.7	4	0	1.0	1.0	missing	21.0	21.0	15.0	15.0	225	15.0

[1999 05/03 23:47:44 UTC]

RowName	Type	Azimuth	Range	CellId	MesoId	Base	Top	Depth	LLgtg	MXgtg	LLShear	MXShear	Dir	Speed
5	TVS	255	43.6	6	0	0.5	9.1	8.7	51.0	56.0	67.0	76.0	missing	missing
2	TVS	253	107.3	2	0	1.6	10.0	9.1	41.0	52.0	22.0	28.0	211	13.0
11	TVS	253	104.9	2	0	1.5	10.0	8.5	28.0	59.0	15.0	33.0	201	48.0
4	TVS	305	125.5	1	0	2.0	9.5	7.5	24.0	52.0	11.0	24.0	211	26.0
1	TVS	254	41.7	6	40	0.4	9.5	7.1	23.0	86.0	32.0	93.0	231	18.0
23	TVS	295	78.7	4	0	1.0	10.0	8.9	21.0	21.0	15.0	15.0	225	15.0

RAPID UPDATE DESIGN REVIEW

- 2002 MOU work:
  - The display and attribute table values of *ALL* features should be coasted.
  - The display and attribute tables should be updated once there is enough information to determine that a 3D feature exists (not just on the base tilt and for topped detections).

  - Evaluate end of volume scan information from the rapid update and non-rapid update systems.
  - Determine average increase in time the rapid update system provides in detecting severe weather features.
  - Note failure rates of rapid update first guesses.